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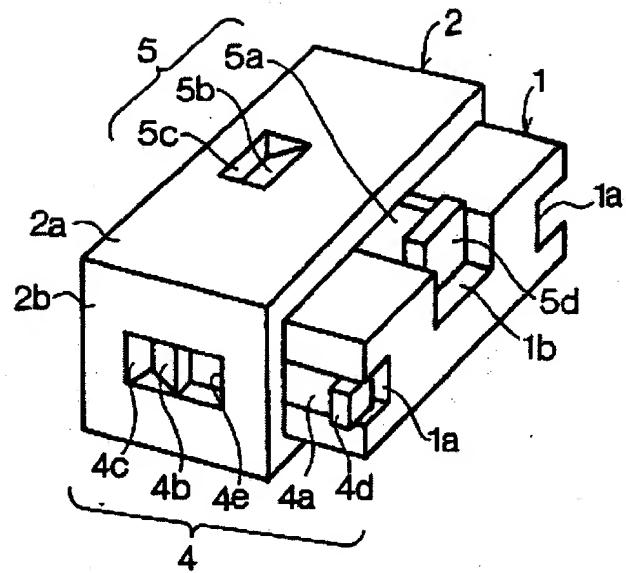


FIG. 1

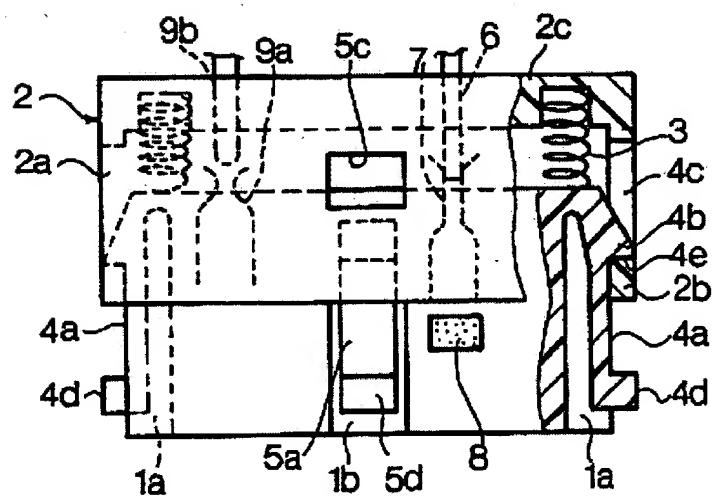


FIG. 2

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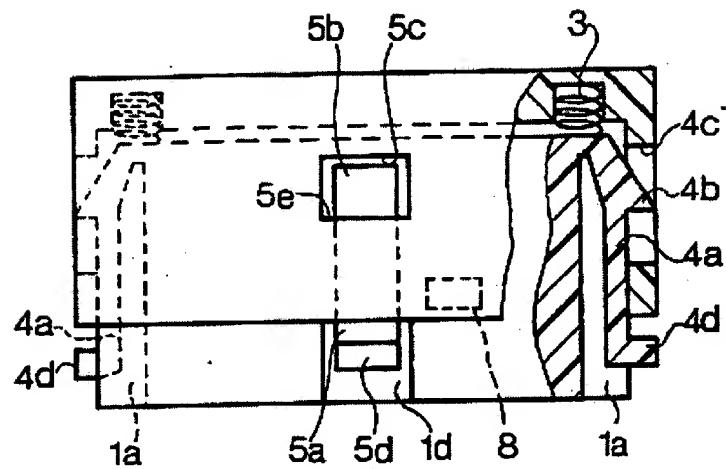


FIG. 3

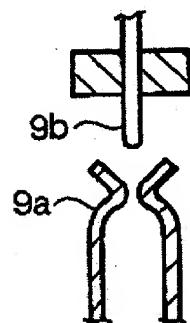


FIG. 4b

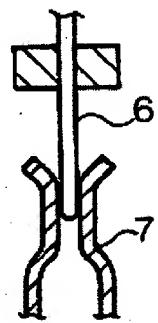


FIG. 4a

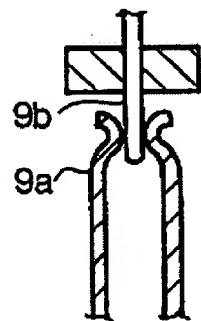


FIG. 5b

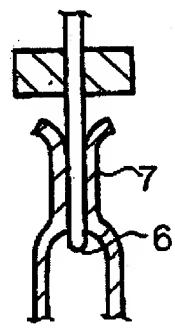


FIG. 5a

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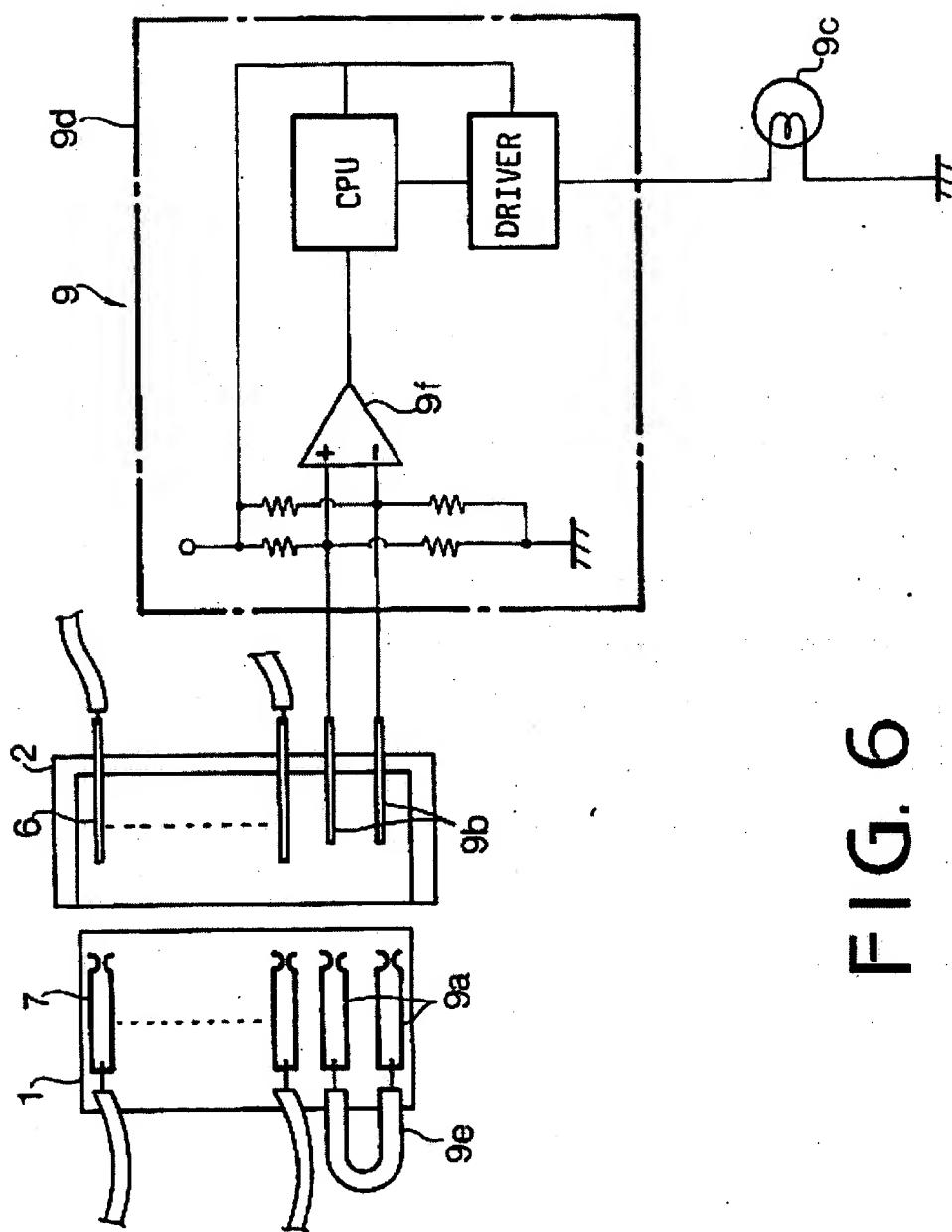


FIG. 6

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A CONNECTOR ASSEMBLY

The present invention relates to a detachable connector assembly with lock mechanism for an electronic device such as an electronic control system for automobiles.

Japanese Utility Model Application Laid-Open 53-101638 discloses a connector assembly for electrical equipment of an automobile. The connector assembly comprises a plug, a socket, and a lock mechanism for holding the plug and socket in a connected state so that disconnection of the plug from the socket may be prevented.

However, if locking of the connector is incomplete, the plug may be disconnected from the socket with vibration of the connector or with a shock caused by an impact of the automobile. If the connector is disconnected, dangerous faults, such as failure of safety devices, for example inflating air bags, can occur.

In general, even if the lock of the connector is incomplete, electrical connection is maintained. Consequently, the incomplete locked state of the connector is not discernible to the driver.

The object of the present invention is to provide a connector with a lock mechanism in which an incomplete locked state of the connector is indicated.

According to the present invention there is provided a connector assembly comprising:

a plug having contacts and adapted for insertion in a socket having a structure for receiving the plug and pins engageable with the contacts;

a first lock mechanism for locking the plug at a partially inserted first position;

a second lock mechanism for locking the plug at a second position more fully inserted than the first position;

indicator means for indicating when the second lock mechanism locks the plug.

Preferably, each lock mechanism comprises a hook formed on the plug and an opening in the socket into which the hook is receivable. The indicator means may be a mark provided on the plug, which is obscured only when the second lock mechanism is locked.

Other objects and features of this invention will become understood from the following description with reference to the accompanying drawings.

Fig. 1 is a perspective view of a connector with a lock mechanism according to the present invention;

Fig. 2 is a plan view of the connector showing a pre-lock position of the lock mechanism, partly shown in section;

Fig. 3 is a plan view of the connector showing a lock position of the lock mechanism, partly shown in section;

Figs. 4a and 4b are illustrations showing a

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connector terminal and a detector terminal at the pre-lock position of the connector;

Figs. 5a and 5b are illustrations showing the connector terminal and the detector terminal at the lock position of the connector; and

Fig. 6 is a diagram of an alarm device of the present invention.

Referring to Figs. 1 to 3, a connector according to the present invention comprises a plug 1, a socket 2 into which the plug 1 is inserted. The socket 2 has a box structure having an upper plate 2a, both side plates 2b, and an end plate 2c. A pair of coil springs 3 are provided in the end plate 2c of the socket 2 for outwardly urging the plug 1 when inserted.

As a lock mechanism, the connector is provided with a first lock mechanism 4 and a second lock mechanism 5, each of which is operated at different insert distances of the plug 1.

The first lock mechanism 4 comprises a pair of grooves 1a, 1a formed in right and left side walls of the plug 1, and a cantilevered resilient lock arm 4a disposed in each groove 1a. The resilient arm 4a extends in the inserting direction of the plug and has a hook 4b outwardly projected from a base portion thereof. A pair of rectangular openings 4c are formed on the side plates 2b of the socket 2. The hook 4b is adapted to be inserted into the opening 4c and engaged with an edge 4e. A boss 4d is formed at a free end of the resilient arm 4a. By inwardly pushing the boss 4d of both the arms 4a, the hook 4b are disengaged from the edges 4e.

The second lock mechanism 5 comprises a groove 1b formed on an upper side of the plug 1 in the center thereof, a cantilevered resilient arm 5a formed to be disposed in the groove 1b, a hook 5b provided adjacent to a base portion of the arm 5a, a rectangular opening 5c formed on the upper plate 2a of the socket 2, having an edge 5e to be engaged with the hook 5b, and a boss 5d formed on a free end of the arm 5a. By pushing the boss 5d, the engaging hook 5b is disengaged from the opening 5c.

As shown in Fig. 2, the opening 4c of the first lock mechanism 4 is located at a short insertion distance, and the opening 5c is located at a long insertion distance.

As a connector terminal of the connector, a plurality of pins 6 are provided in the socket 2 and a plurality of resilient contacts 7 corresponding to pins 6 are provided in the plug 1. Further, as a detector terminal, a pair of pins 9b is provided in the socket 2 (Fig. 6) and a pair of resilient contacts 9a are provided in the plug 1.

When the plug 1 is inserted into the socket 2 and the hooks 4b of the resilient arms 4a are engaged with the edges 4e of openings 4c of the socket 2, the plug is locked at a pre-lock position. As shown in Fig. 4a, the pin 6 is inserted into the contact 7 by the short insertion distance, where the pin 9b does not engage with the contact 9a.

When the plug 1 is further inserted into the socket 2 and the hook 5b is engaged with the edge 5e of opening 5c, the

plug 1 is finally locked so that each pin 6 is further inserted into the contact 7 up to the long insertion distance position as shown in Fig. 5a, where the pin 9b engages with contact 9a.

In order to indicate the fact that the plug 1 is finally locked to socket 2, a mark 8 is provided on the upper side of the plug 1. In the pre-lock state by means of the first lock mechanism 4, the mark 8 is exposed on the surface of the plug 1. In the lock state by means of the second lock mechanism 5, the mark 8 is disappeared behind the socket 2.

Referring to Fig. 6, an alarm device 9 is further provided. The alarm device 9 comprises two detector terminals consisting of a pair of pins 9b, a pair of contacts 9a, a lighting control circuit 9d and an alarm lamp 9c. The contacts 9a are connected each other through a lead 9e and pins 9b are connected to a comparator 9f provided in the lighting control circuit 9d. A CPU and a driver for driving the alarm lamp 9c are provided in the circuit 9d. When the pins 9a do not engage with the contacts 9b, the comparator 9f produces an output signal to light the lamp 9c. When the pins 9a engage with the contacts 9b, the output of the comparator 9f becomes zero, so that the alarm lamp 9c is turned off.

Each pin 9a is shorter than pin 6 in length. As described above, when the plug 1 is at the pre-lock position by means of the first lock mechanism 4, the pin 9b do not engage with the contacts 9a.

When the plug 1 is inserted into the socket 2 to an inner most position against the springs 3, the hook 5b is engaged with the edge 5e of the opening 5c as shown in Fig. 3. Thus, the connector is held in the lock position with the second lock mechanism 5 and the pins 6 are sufficiently engaged with the contacts 7 as shown in Fig. 5a. At the same time, the pins 9b engage with the contacts 9a as shown in Fig. 5b. Accordingly, the alarm lamp 9c is turned off and the mark 8 on the plug 1 is disappeared behind the socket 2.

If the locked state by the second lock mechanism 5 is incomplete, the plug 1 is pushed out by the springs 3 and held in the pre-lock position by the first lock mechanism 4 as shown in Fig. 2. The mark 8 is appeared on the plug 1 and the alarm lamp 9c is lighted. Thus, the incomplete lock state of the connector is indicated. Then, the plug 1 is pushed into the socket 2 so that the plug is finally locked by the second lock mechanism 5.

In present invention, if locked state by the second lock mechanism is incomplete, the plug is held to the pre-lock position by the first lock mechanism, and the incomplete connection is indicated.